76315

Micropoikilitic Impact Melt Breccia
671.1 g, 10 x 12 x 4.5 cm

INTRODUCTION

Sample 76315 was chipped from the side of the big boulder at Station 6 (Fig. 1). This blue-grey breccia sample is part of lithology AB, which is mapped as a "transitional zone" on Block 2 by Heiken et al. (1973). Sample 76315 is a micro-poikilitic impact melt breccia that has been studied by many investigators. It is typical of the other samples of the big boulder *(see the introduction section on the boulder at Station 6).*

PETROGRAPHY

The surface of 76315 was covered with patina (Fig. 2) to such an extent that the underlying lithology could not be discerned except on the freshly broken B 1 face (Fig. 3). The broken surface was composed of dank grey breccia with a large irregular patch of "pink-grey" material and a 1 x 2 cm light grey clast (Phinney, 1981).

A distinct foliation is apparent in the slab of 76315 due to variations in matrix color, and trains of minute vesicles occur in the matrix. Along one edge of the slab and parallel to the foliation are white patches referred to as "clast 1" by Phinney (1981). However, this brecciated clast was apparently squeezed along the direction of foliation, forming a zone of weakness along which the rock was fractured during sampling from the boulder. The "clast 1" was found to be disappointingly small in volume.

The modal mineralogy of the matrix of 76315 is about 50% plagioclase and 40% low-calcium pyroxene with minor amounts of augite, olivine, ilmenite, armalcolite, and metallic iron (Fig. 4). The texture of the matrix of 76315 is micropoikilitic and similar to the matrix of the other samples of the large boulder (Simonds et at., 1974). The matrix consists dominantly of low-calcium pyroxene ($Wo_4En_{60-73}Fs_{19-26}$), minor augite ($W0_{30-40}En_{44-57}Fs_{12-15}$), olivine ($Fo_{70-76}$), and feldspar ($An_{81-97}$). The grain size of matrix feldspar is ~10 µm; pyroxene is 25-30 µm. Histograms of matrix

Figure 1: Photo of the downhill side of Block 2 of the Station 6 Boulder where sample 76315 was chipped . AS17-140-21436.

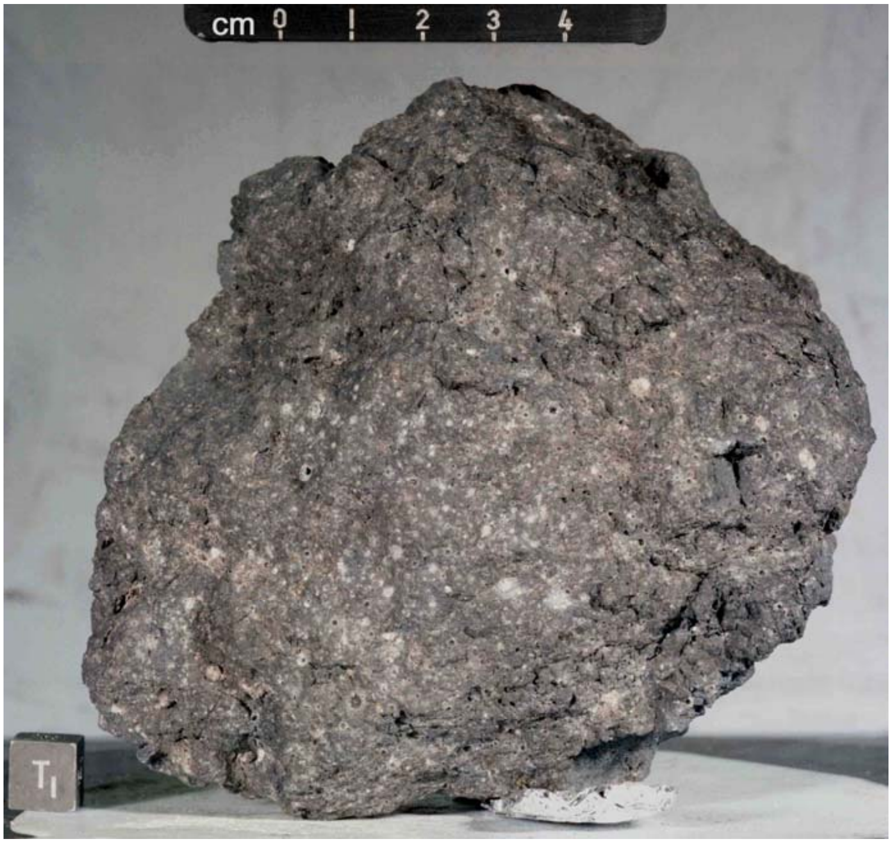

Figure 2: Exterior surface of 76315, showing thick patina and many micrometeorite pits. Scale is 1 cm. S73-17108.

mineral compositions (Fig. 5) from widely separated regions, including subophitic and micropoikiltic regions, showed similar compositions (Simonds et al., 1974).

Simonds et al. (1974) studied numerous small lithic clasts in 20 thin sections of 76315, including two poikilitic 70-80% feldspar fragments, three granulitic 70-80% feldspar fragments, one crushed feldspar or anorthosite fragment, three intersertal feldspar-pyroxene-olivine fragments, one crushed olivine or dunite, one poikilitic 50-60% feldspar fragment, two crushed spine]-olivine fragments, one crushed troctolite fragment, and three aphanitic feldspathic fragments. Among the mineral clasts in 76315, pyroxenes and olivine fragments range in Mg/Fe ratios above and below the composition of the matrix pyroxene (Simonds et al., 1974). The clast population in 76315 has also been studied by Norman et al. (1993).

Misra et al. (1976) have studied the complex metallic nickel-iron particles included in 76315.

WHOLE-ROCK CHEMISTRY

Simonds (1975) gives the chemical composition of 76315 and two of its clasts (Table 1). Morgan et al. (1974) and Gros et al. (1976) have determined the siderophile and trace element abundance of matrix and clasts in 76315 (Table 2). Jovanovic and Reed (1975) have determined F, Cl, I, Li, U, Ru, and Os in external and internal pieces of 76315. Allen et al. (1975) have reported heavy element abundances.

James (1994) has carefully reviewed the volatile and siderophile elements in Apollo 17 melt rock. There is remarkable similarity in the patterns of these elements in the matrices of all these samples.

SIGNIFICANT CLASTS

Clast 1 (, 52) was a thin white rind along the side of the sample. The white rind's mineral mode, mineral composition, bulk composition, and textural data are reported in Simonds (1975) (Fig. 6). This granulitic cast has ~70% plagioclase (An_{95}), ~15% pigeonite ($Wo_{3-5}En_{83}Fs_{12}$), and ~15% olivine (Fo_{82}). See also the REE diagram (Fig. 7).

Figure 3: Freshly broken surface of 76315 showing two large, prominent clasts. The large pinkish-white clast (class 1) was found to be very thin. The light grey clast (clast 2) was found to have a coarse poikilitic texture. The large pinkish-white clast was apparently a zone of weakness where the fragment broke from the boulder. Scale is 1 cm. S73-17109.

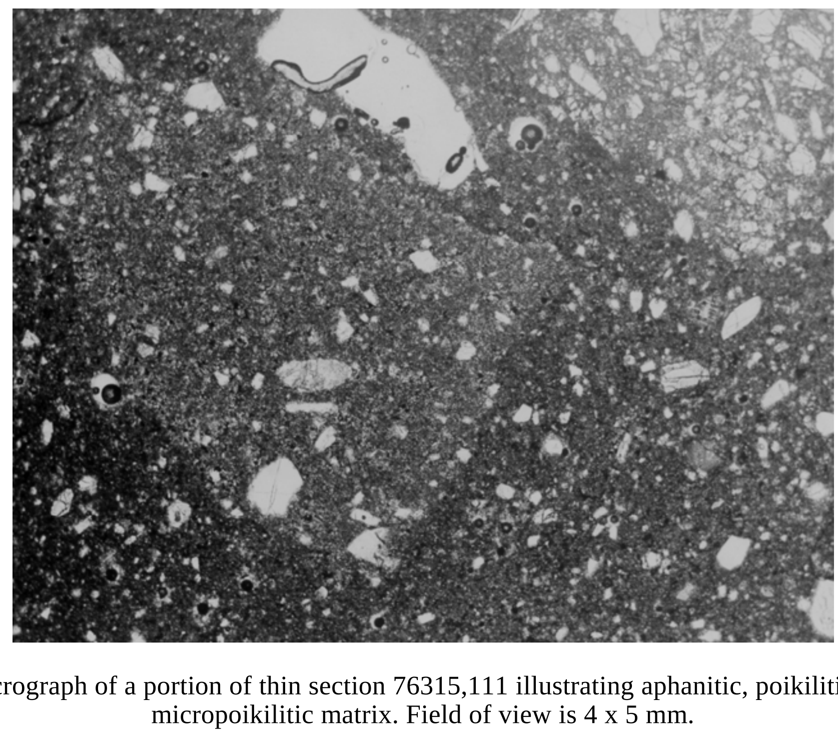

Figure 4: Photomicrograph of a portion of thin section 76315,111 illustrating aphanitic, poikilitic clast in aphanitic, micropoikilitic matrix. Field of view is 4 x 5 mm.

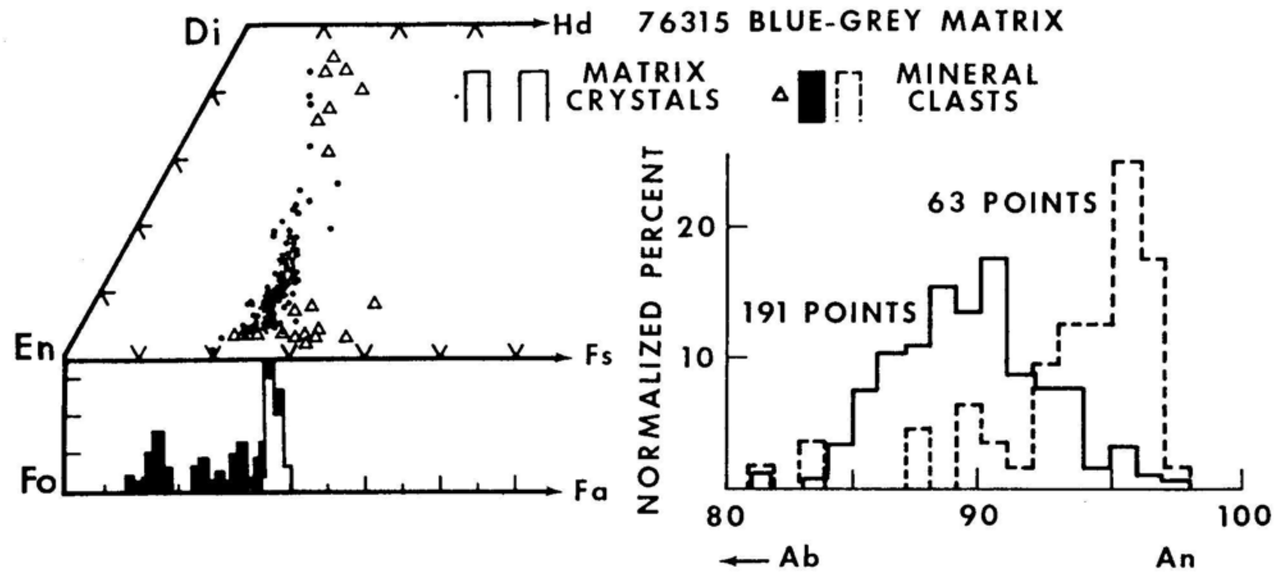

Figure 5: Composition of minerals in matrix of 76315 (from Simonds et al., 1974). Note the Ca-rich plagioclase and Mg-rich pyroxene mineral inclusions in the matrix.

Clast 2 (,62) was a light grey, poikilitic-texture, "anorthositic" clast with ~70% plagioclase (An_{95}), ~17% pigeonite ($Wo_{3-5}En_{78}Fs_{18}$), and ~13% olivine (Fo_{75}). The minerals in this clast were found to be very homogeneous in composition (Fig. 6).

RADIOGENIC ISOTOPES

Turner and Cadogan (1975 and 1976) report a well-defined Ar plateau age of 3.98 ±.04 b.y. for the matrix of 76315. The white anorthositic clast (,61) appears to have retained Ar from an older event (Fig 8) in the highest temperature release.

Nyquist et al. (1974) report Rb-Sr data for several splits of matrix from 76315 and note that the Rb-Sr systematics are probably partially reset by the Serenitatus impact event (Table 3). Unpublished U-Th-Pb data by Leon Silver were also reported in Phinney (1981).

COSMOGENIC RADIOISOTOPES AND EXPOSURE AGES

Concordant ^{81}Kr-Kr and cosmic ray track ages from sample 76315 show that the Station 6 Boulder tumbled or rolled to the present position at the base of the North Massif 22 m.y. ago (Crozaz et al., 1974a). The incorrect 11 m.y. exposure age originally reported by Heiken et al. (1973) becomes consistent with the 22 m.y. age when one takes into account the fact that this sample was from the side of the boulder and only exposed to half the sky. Apparently, Heiken et al. incorrectly used product:Lon rates calculated on the basis of assumed 2n geometry (see discussion in Arvidson et al., 1975).

Turner and Cadogan (1975) reported a poorly defined Ar exposure age of around 13 m.y.

Bogard et al. (1974) have studied the rare gases in a large number of subsamples of 76315 (see unpublished data reported in Phinney, 1981).

MAGNETIC STUDIES

Pearce et al. (1974) and Gose et al. (1978) have carefully studied the remanent magnetization of 26 subsamples from the Station 6 Boulder. The direction of magnetization of sample 76315 (from unit AB) was difficult to determine because the high metallic iron content caused it to be very susceptible to the acquisition of an anhysteretic magnetism or a viscous magnetization. However, the direction of magnetization of this sample is more uniform

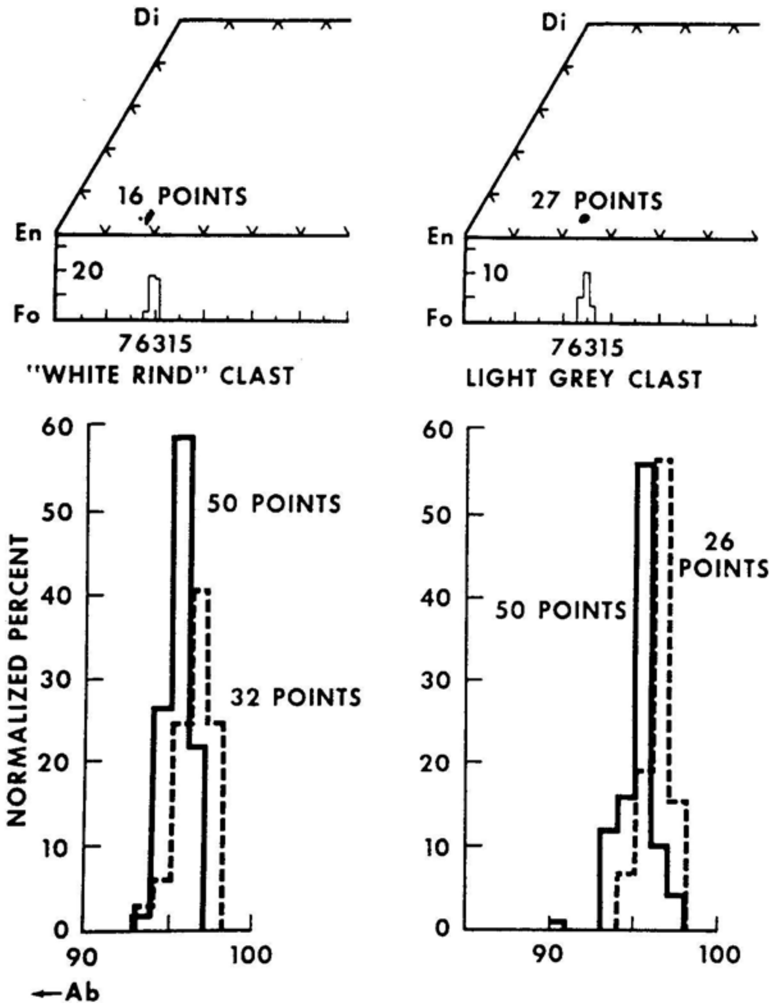

Figure 6: Plagioclase, olivine, and pyroxene composition in white-rind clast 1 and light grey clast 2 . from 76315 (Simonds, 1975).

than for the more clast-rich samples. Nagata (1975) has reported the intensity of saturation magnetization for 76315. Brecher (1976) has proposed textural remanence in 76315. Stephenson et al. (1974) also attempted to determine the lunar magnetic field paleointensity using 76315.

SURFACE STUDIES

Adams and Charette (1975) have determined the reflectance spectra of the surface of 76315 and report that the spectra of poikilitic rocks are similar to KREEP with a slight upturn at the high wavelength (Fig. 9). It would be interesting to determine the difference in spectra for patina covered surfaces as compared with fresh surfaces of lunar rocks. The lack of a significant pyroxene adsorption band at 0.9 pm may be due to the thick glass patina on the surface of 76315.

PROCESSING

A slab and a column were cut from this rock (see lithology maps and diagrams in Phinney, 1981).

Samples of 76315 were allocated for several studies of "physical properties." Gold et al. (1976) determined "electrical properties." Housley et al. (1976) have deter-mined the ferromagnetic resonance. Hoffman et al. (1974) have determined the iron distribution by Mossbauer spectroscopy.

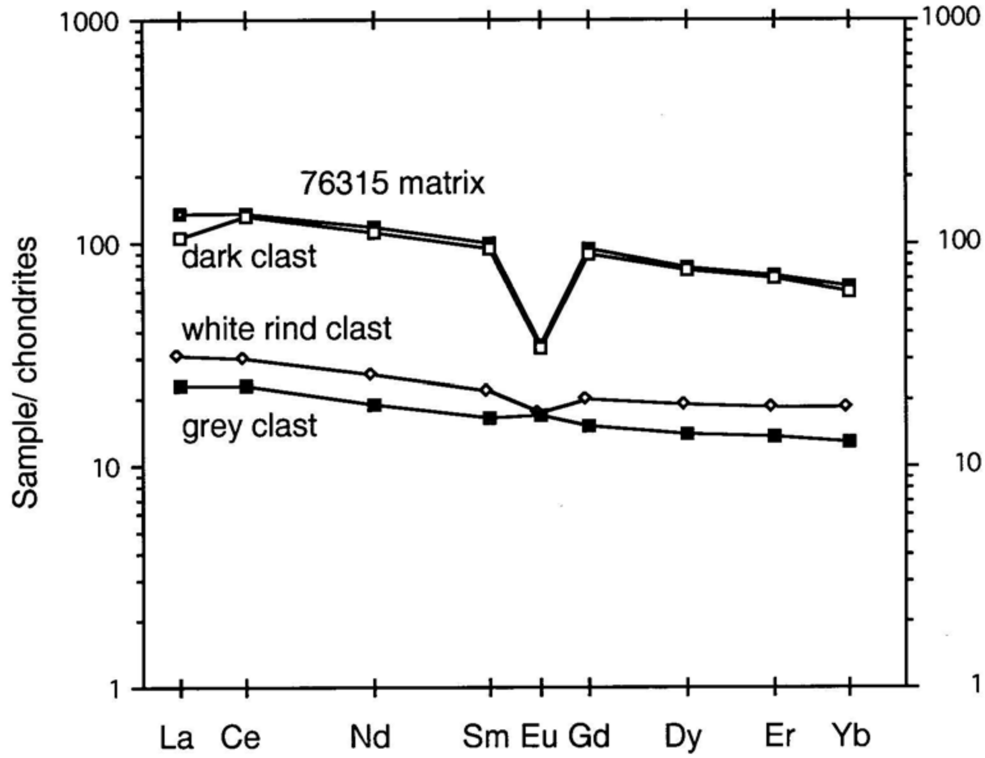

Figure 7: Normalized rare earth element diagram for matrix and clasts 1 and 2 in 76315.

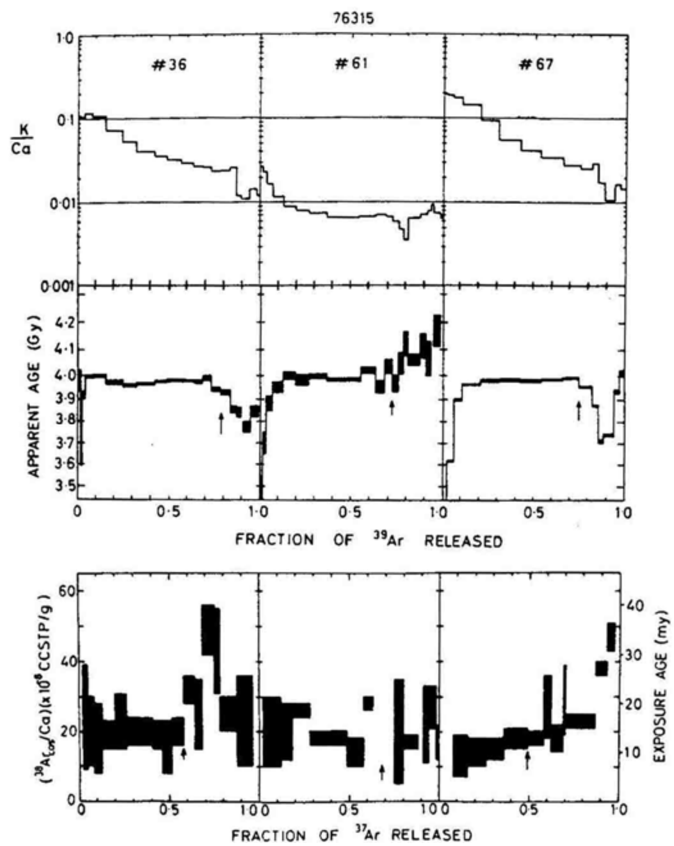

Figure 8: Ar-Ar plateau age of matrix and clasts in 76315. From Turner and Cadogan (1975).

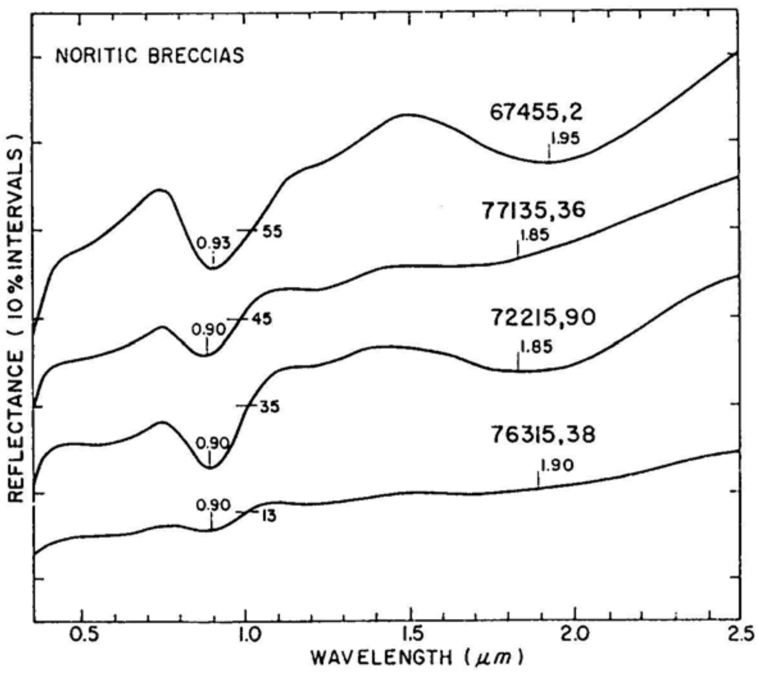

Figure 9: Reflectance spectra of 76315. By Adams and Charette (1975).

Table 1: Whole-rock and clast chemistry of 76315.
a) LSPET (1973); b) Rhodes et al. (1974a); c) Hubbard et al.. (1974); Wiesmann and Hubbard (1975)

Split Technique	,2 (a, c) XRF, IDMS	,30M (b, c) XRF, IDMS matrix	,30,3 (b, c) XRF, IDMS clast	,35M (b, c) XRF, IDMS matrix	,52 (b, c) XRF, IDMS clast	,62 (b, c) XRF, IDMS clast
SiO_2 (wt%)	45.82	45.64	46.45	46.21	48.57	45.10
TiO_2	1.47	1.50	1.43	1.50	0.32	0.36
Al_2O_3	18.01	17.53	18.18	18.14	17.91	26.37
Cr_2O_3	0.19	0.19	0.20	0.19	0.12	0.11
FeO	8.94	9.53	8.83	8.95	7.66	5.29
MnO	0.11	0.13	0.13	0.12	0.13	0.07
MgO	12.41	12.50	12.34	12.02	13.84	7.46
CaO	11.06	10.97	11.30	11.32	10.36	15.12
Na_2O	0.57	0.70	0.64	0.60	0.47	0.47
K_2O	0.27	0.26	0.22	0.26	0.15	0.10
P_2O_5	0.29	0.30	0.29	0.29	0.12	0.06
S	0.08	0.08	0.07	0.07	0.00	0.04
Nb (ppm)	33	33	32	33	–	
Zr	477	485	465	522	105	95
Hf	12.5	–	11.9	–	–	5.3
U	1.52	1.47	1.36	2.52	0.34	0.343
Th	5.2	5.36	5.23	5.69	1.34	1.234
Y	111	113	107	111	–	
Sr	180	175	172	174	115	153
Rb	5.88	6.56	3.85	5.78	3.73	2.336
Li	14.6	15.6	14.1	13.9	11.8	9.5
Ba	359	349	366	337	129	72.8
Zn	4	3	2	4	–	
Ni	149	77	82	74	–	
La	30.1	32.9	24.7	31.6	7.33	5.41
Ce	84.6	84.0	78.6	82.3	18.4	13.7
Nd	53.5	53.5	50.2	52.7	11.5	8.6
Sm	15.1	15.1	14.1	14.8	3.2	2.42
Eu	2.00	1.97	1.88	1.95	0.971	0.94
Gd	18.9	18.5	17.6	18.8	3.93	2.99
Dy	19.9	19.7	18.3	19.1	4.59	3.39
Er	11.7	11.5	11.0	11.4	2.91	2.14
Yb	11.0	10.6	10.0	10.4	2.98	2.07
Lu	–	–	–		.455	0.30

Table 2: Trace element data for 76315. Concentrations in ppb.
a) Gros et al. (1976); b) Morgan et al. (1974).

	Sample (a) 76315,118 clast	Sample (b) 76315,73 matrix	Sample (b) 76315,74
Ir	18.6	5.42	5.97
Os	20.9		
Re	1.85	0.507	0.575
Au	6.41	3.21	3.48
Pd	22.6		
Ni (ppm)	423	256	260
Sb	0.85	1.49	1.54
Ge	57.7	346	354
Se	71	100	107
Te	3.4	4.04	5.1
Ag	0.72	0.84	0.88
Br	39.2	48	44
In	4.61		
Bi	0.44	0.098	0.28
Zn (ppm)	2	3.1	3.4
Cd	12.1	5	6.4
Tl	1.6	0.31	0.34
Rb (ppm)	2.73	5.91	5.9
Cs	110	250	250
U	355	1540	1490

Table 3: Rb-Sr composition of 76315.
Data from Nyquist et al. (1974).

Sample	76315,2	,35M	,30C3	,30M	,52	,62
wt (mg)	52.4	49.2	66.7	51.6	38.9	52.5
Rb (ppm)	5.88	5.78	3.85	6.56	3.73	2.34
Sr (ppm)	179.5	174.4	171.5	174.8	115.2	153.1
$^{87}Rb/^{86}Sr$	0.0948 ± 8	0.0960 ± 8	0.0650 ± 6	0.1086 ± 9	0.0937 ± 9	0.0441 ± 5
$^{87}Sr/^{86}Sr$	0.70515 ± 5	0.70521 ± 7	0.70351 ± 10	0.70595 ± 5	0.70491 ± 6	0.70185 ± 5
T_B	4.45 ± 0.08	4.44 ± 0.09	4.72 ± 0.14	4.40 ± 0.08	4.33 ± 0.08	4.35 ± 0.13
T_L	4.50 ± 0.08	4.49 ± 0.09	4.80 ± 0.14	4.46 ± 0.08	4.40 ± 0.08	4.46 ± 0.13

B = Model age assuming I = 0.69910 (BABI + JSC bias)
L = Model age assuming I = 0.69903 (Apollo 16 anorthosites for T = 4.6 b.y.)